Science Technicians

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Significant Points

- Science technicians in production jobs often work in 8-hour shifts around the clock.
- Job opportunities are expected to be very good for qualified graduates of science technician training programs or applied science technology programs who are well trained on equipment used in laboratories and production facilities.

Nature of the Work

Science technicians use the principles and theories of science and mathematics to solve problems in research and development and to help invent and improve products and processes. However, their jobs are more practically oriented than those of scientists. Technicians set up, operate, and maintain laboratory instruments, monitor experiments, make observations, calculate and record results, and often develop conclusions. They must keep detailed logs of all their work-related activities. Those who work in production monitor manufacturing processes and may be involved in ensuring quality by testing products for proper proportions of ingredients, purity, or for strength and durability.

As laboratory instrumentation and procedures have become more complex in recent years, the role of science technicians in research and development has expanded. In addition to performing routine tasks, many technicians also develop and adapt laboratory procedures to achieve the best results, interpret data, and devise solutions to problems, under the direction of scientists. Moreover, technicians must master the laboratory equipment, so they can adjust settings when necessary, and recognize when equipment is malfunctioning.

The increasing use of robotics to perform many routine tasks has freed technicians to operate more sophisticated laboratory equipment. Science technicians make extensive use of computers, computer-interfaced equipment, robotics, and high-technology industrial applications, such as biological engineering.

Most science technicians specialize, learning skills and working in the same disciplines as scientists. Occupational titles, therefore, tend to follow the same structure as scientists. *Agricultural technicians* work with agricultural scientists in food, fiber, and animal research, production, and processing. Some conduct tests and experiments to improve the yield and quality of crops or to increase the resistance of plants and animals to disease, insects, or other hazards. Other agricultural technicians do animal breeding and nutrition work.

Biological technicians work with biologists studying living organisms. Many assist scientists who conduct medical research—helping to find a cure for cancer or AIDS, for example. Those who work in pharmaceutical companies help develop and manufacture medicinal and pharmaceutical preparations. Those working in the field of microbiology generally work as lab assistants, studying living organisms and infectious agents. Biological technicians also analyze organic substances, such as blood, food, and drugs, and some examine evidence in criminal investigations. Biological technicians working in biotechnology labs use the knowledge and techniques gained from basic research by scientists, including gene splicing and recombinant DNA, and apply these techniques in product development.

Chemical technicians work with chemists and chemical engineers, developing and using chemicals and related products and equipment. Most do research and development, testing, or other laboratory work. For example, they might test packaging for design, integrity of materials, and environmental acceptability; assemble and operate new equipment to develop new products; monitor product quality; or develop new production techniques. Some chemical technicians collect and analyze samples of air and water to monitor pollution levels. Those who focus on basic research might produce compounds through complex organic synthesis. Chemical technicians within chemical plants are also referred to as *process technicians*. They may operate equipment, monitor plant processes and analyze plant materials.

Environmental technicians perform laboratory and field tests to monitor environmental resources and determine the contaminants and sources of pollution. They may collect samples for testing or be involved in abating, controlling, or remediating sources of environmental pollutants. Some are responsible for waste management operations, control and management of hazardous materials inventory, or general activities involving regulatory compliance. There is a growing emphasis on pollution prevention activities.

Nuclear technicians operate nuclear test and research equipment, monitor radiation, and assist nuclear engineers and physicists in research. Some also operate remote control equipment to manipulate radioactive materials or materials to be exposed to radioactivity.

Petroleum technicians measure and record physical and geologic conditions in oil or gas wells, using instruments lowered into wells or by analysis of the mud from wells. In oil and gas exploration, these technicians collect and examine geological data or test geological samples to determine petroleum and mineral content. Some petroleum technicians, called *scouts*, collect information about oil and gas well drilling operations, geological and geophysical prospecting, and land or lease contracts.

Other science technicians collect weather information or assist oceanographers.

Working Conditions

Science technicians work under a wide variety of conditions. Most work indoors, usually in laboratories, and have regular hours. Some occasionally work irregular hours to monitor experiments that can't be completed during regular working hours. Production technicians often work in 8-hour shifts around the clock.

Science technicians put theory into practice.

Others, such as agricultural, petroleum, and environmental technicians, perform much of their work outdoors, sometimes in remote locations.

Some science technicians may be exposed to hazards from equipment, chemicals, or toxic materials. Chemical technicians sometimes work with toxic chemicals or radioactive isotopes, nuclear technicians may be exposed to radiation, and biological technicians sometimes work with disease-causing organisms or radioactive agents. However, these working conditions pose little risk, if proper safety procedures are followed.

Employment

Science technicians held about 227,000 jobs in 1998. Over 37 percent worked in manufacturing—mostly in the chemical industry—but also in the food processing industry. About 12 percent worked in education services, and another 15 percent worked in research and testing services. In 1998, the Federal Government employed about 14,000 science technicians, mostly in the Departments of Defense, Agriculture, and Interior.

Training, Other Qualifications, and Advancement

There are several ways to qualify for a job as a science technician. Many employers prefer applicants who have at least 2 years of specialized training or an associate degree in applied science or science-related technology. Because employers' preferences vary, however, some science technicians have a bachelor's degree in chemistry or biology or have taken several science and math courses at 4-year colleges.

Many technical and community colleges offer associate degrees in a specific technology or a more general education in science and mathematics. A number of 2-year associate degree programs are designed to provide easy transfer to a 4-year college or university, if desired. Technical institutes usually offer technician training, but provide less theory and general education than technical or community colleges. The length of programs at technical institutes varies, although 1-year certificate programs and 2-year associate degree programs are common. Some schools offer cooperative-education or internship programs, allowing students the opportunity to work at a local company or other workplace, while attending classes in alternate terms. Participation in such programs can significantly enhance a student's employment prospects.

Persons interested in careers as science technicians should take as many high school science and math courses as possible. Science courses taken beyond high school, in an associate's or bachelor's program, should be laboratory oriented, with an emphasis on bench skills. Because computers and computer-interfaced equipment are often used in research and development laboratories, technicians should have strong computer skills. Communication skills are also important; technicians are often required to report their findings both through speaking and in writing. Additionally, technicians should be able to work well with others, because teamwork is common.

Prospective science technicians can acquire good career preparation through 2-year formal training programs that combine the teaching of scientific principles and theory with practical hands-on application in a laboratory setting with up-to-date equipment. Graduates of 4-year bachelor's degree programs in science who have considerable experience in laboratory-based courses, have completed internships, or held summer jobs in laboratories, are also well-qualified for science technician positions and are preferred by some employers. However, those with a bachelor's degree who accept technician jobs generally cannot find employment that uses their advanced academic education.

Technicians usually begin work as trainees in routine positions, under the direct supervision of a scientist or a more experienced technician. Job candidates whose training or educational background encompasses extensive hands-on experience with a variety of laboratory equipment, including computers and related equipment, usually require a short period of on-the-job training. As they gain experience, technicians take on more responsibility and carry out assignments under only general supervision, and some eventually become supervisors. However, technicians employed at universities often have their fortunes tied to particular professors; when professors retire or leave, these technicians face uncertain employment prospects.

Job Outlook

Employment of science technicians is expected to increase more slowly than the average for all occupations through the year 2008. Continued growth of scientific and medical research, as well as the development and production of technical products, should stimulate demand for science technicians in all areas. In particular, the growing number of agricultural and medicinal products developed from using biotechnology techniques will increase the need for biological technicians. Employment growth will also be fueled by demand for technicians to help regulate waste products; to collect air, water, and soil samples for measuring levels of pollutants; to monitor compliance with environmental regulations; and to clean up contaminated sites. However, growth will be moderated somewhat by an expected slowdown in overall employment in the chemical industry.

Job opportunities are expected to be very good for qualified graduates of science technician training programs or applied science technology programs, who are well trained on equipment used in industrial and government laboratories and production facilities. As the instrumentation and techniques used in industrial research, development, and production become increasingly more complex, employers are seeking well trained individuals with highly developed technical and communication skills. In addition to opportunities created by growth, many job openings should arise from the need to replace technicians who retire or leave the labor force for other reasons.

Earnings

Median hourly earnings of science technicians were $14.92 in 1998. The middle 50 percent earned between $11.48 and $19.38. The lowest 10 percent earned less than $9.28 and the highest 10 percent earned more than $24.20. Median hourly earnings were $11.20 for chemical technicians and $11.80 for biological and agricultural technicians working in research and testing services in 1997. Chemical technicians working in drug manufacturing earned an hourly median of $15.30 in 1997. Median hourly earnings in the industries employing the largest number of all other science technicians in 1997 were as follows:

Federal Government	$16.50
State government, except education and hospitals	14.80
Local government, except education and hospitals	14.50
Research and testing services	14.40
Personnel supply services	11.30

In the Federal Government in 1999, science technicians started at $16,400, $18,400, or $20,600, depending on education and experience. Beginning salaries were slightly higher in selected areas of the country where the prevailing local pay level was higher. The average annual salary for biological science technicians in nonsupervisory, supervisory, and managerial positions employed by the Federal Government in early 1999 was $30,300; for mathematical technicians, $41,000; for physical science technicians, $38,200; for geodetic technicians, $48,800; for hydrologic technicians, $36,000; and for meteorologic technicians, $45,200.

Related Occupations

Other technicians who apply scientific principles at a level usually taught in 2-year associate degree programs include engineering technicians,

broadcast technicians, drafters, and health technologists and technicians. Some of the work of agricultural and biological technicians is related to that in agriculture and forestry occupations.

Sources of Additional Information

For information about a career as a chemical technician, contact:

☛ American Chemical Society, Education Division, Career Publications, 1155 16th St. NW., Washington, DC 20036. Internet: **http://www.acs.org**

Legal Occupations

Lawyers and Judicial Workers

(O*NET 28102, 28105, and 28108)

Significant Points

- Formal educational requirements for lawyers include a 4-year college degree, 3 years in law school, and successful completion of a written bar examination.
- Competition for admission to most law schools is intense.
- Aspiring lawyers and judges should encounter significant competition for jobs.

Nature of the Work

The legal system affects nearly every aspect of our society, from buying a home to crossing the street. Lawyers and judicial workers form the backbone of this vital system, linking the legal system and society in myriad ways. For this reason, they hold positions of great responsibility and are obligated to adhere to a strict code of ethics.

Lawyers, also called *attorneys*, act both as advocates and advisors in our society. As advocates, they represent one of the parties in criminal and civil trials by presenting evidence and arguing in court to support their client. As advisors, lawyers counsel their clients concerning their legal rights and obligations and suggest particular courses of action in business and personal matters. Whether acting as advocate or advisor, all attorneys research the intent of laws and judicial decisions and apply the law to the specific circumstances faced by their client.

The more detailed aspects of a lawyer's job depend upon his or her field of specialization and position. While all lawyers are licensed to represent parties in court, some appear in court more frequently than others. Trial lawyers, who specialize in trial work, must be able to think quickly and speak with ease and authority. In addition, familiarity with courtroom rules and strategy are particularly important in trial work. Still, trial lawyers spend the majority of their time outside the courtroom conducting research, interviewing clients and witnesses, and handling other details in preparation for trial.

Lawyers may specialize in a number of different areas, such as bankruptcy, probate, international, or elder law. Those specializing in environmental law, for example, may represent public interest groups, waste disposal companies, or construction firms in their dealings with the Environmental Protection Agency (EPA) and other State and Federal agencies. They help clients prepare and file for licenses and applications for approval before certain activities may occur. In addition, they represent clients' interests in administrative adjudications.

Some lawyers concentrate in the growing field of intellectual property. These lawyers help protect clients' claims to copyrights, art work under contract, product designs, and computer programs. Still other lawyers advise insurance companies about the legality of insurance transactions. They write insurance policies to conform with the law and to protect companies from unwarranted claims. When claims are filed against insurance companies, they review the claims and represent the companies in court.

The majority of lawyers are found in private practice, where they concentrate on criminal or civil law. In criminal law, lawyers represent individuals who have been charged with crimes and argue their cases in courts of law. Attorneys dealing with civil law assist clients with litigation, wills, trusts, contracts, mortgages, titles, and leases. Other lawyers handle only public interest cases—civil or criminal—which may have an impact extending well beyond the individual client.

Lawyers are sometimes employed full time by a single client. If the client is a corporation, the lawyer is known as "house counsel," and usually advises the company concerning legal issues related to its business activities. These issues might involve patents, government regulations, contracts with other companies, property interests, or collective bargaining agreements with unions.

A significant number of attorneys are employed at the various levels of government. Lawyers who work for State attorneys general, prosecutors, public defenders, and courts play a key role in the criminal justice system. At the Federal level, attorneys investigate cases for the Department of Justice and other agencies. Government lawyers also help develop programs, draft and interpret laws and legislation, establish enforcement procedures, and argue civil and criminal cases on behalf of the government.

Other lawyers work for legal aid societies—private, nonprofit organizations established to serve disadvantaged people. These lawyers generally handle civil, rather than criminal cases. A relatively small number of trained attorneys work in law schools. Most are faculty members who specialize in one or more subjects; however, some serve as administrators. Others work full time in nonacademic settings and teach part time. (For additional information, see the *Handbook* section on college and university faculty.)

To perform the varied tasks described above more efficiently, lawyers increasingly utilize various forms of technology. While all lawyers continue to use law libraries to prepare cases, some supplement their search of conventional printed sources with computer sources, such as the Internet and legal databases. Software is used to search this legal literature automatically and to identify legal texts relevant to a specific case. In litigation involving many supporting documents, lawyers may use computers to organize and index material. Lawyers also use electronic filing, videoconferencing, and voice-recognition technology to more effectively share information with other parties involved in a case.

Many attorneys advance to become *judges* and other *judicial workers*. Judges apply the law and oversee the legal process in courts according to local, State, and Federal statutes. They preside over cases concerning every aspect of society, from traffic offenses to disputes over management of professional sports, or from the rights of huge corporations to questions of disconnecting life support equipment for terminally ill persons. They must ensure that trials and hearings are conducted fairly and that the court administers justice in a manner which safeguards the legal rights of all parties involved.

The most visible responsibility of judges is presiding over trials or hearings and listening as attorneys represent the parties present. Judges rule on the admissibility of evidence and the methods of conducting testimony, and they may be called upon to settle disputes between opposing attorneys. They ensure that rules and procedures are followed, and if unusual circumstances arise for which standard procedures have not been established, judges determine the manner in which the trial will proceed based on their interpretation of the law.